Fermilab

RF 95-degree and RF Cavity LCW Controls
at the MI-60 Pump Room

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Paul Kasley

General Description

The RF and Cavity Control System uses a "shoebox"-style PLC to provide local-only control. Status points for FIRUS monitoring are made available at a terminal block. A local lamp-annunciator Operator Interface (OI) panel assists service personnel in identifying LCW faults.

Voltages for the PLC and its field wiring are derived from a step-down transformer that is powered from the breaker panel driving the Motor Control Centers (MCCs). All field wiring is 24VDC with the exception of the 120VAC needed to activate the MCCs. The PLC is powered by its own 115VAC power supply. An unregulated 24VDC power supply powers the field wiring and the OI.

The PLC is a *PLC-Direct* DL205. This PLC is in use by RD-Safety (now a part of BD-Safety), the controls group (LINAC), and the Pbar department. To keep the load on the PLC power supply within specification, the initial configuration distributes the I/O across two nine-slot bases connected by a remote-I/O link. The CPU base contains a power supply, a processor, a remote I/O master, and three input cards and two relay output. The second base contains a remote I/O slave, two relay output cards and a DC output card. A spare 9-slot base with power supply is used to support off-line relay ladder logic (RLL) programming (The EEPROM in the CPU is programmed at a desk top and the CPU is then moved into the operational base.). The OI panel is connected to the CPU base through a CPU serial port.

The OI panel is an Optimation OM1124. It connects directly to the lower port of the PLC processor through an RS-422 cable. Its 24 indicators are constantly updated with the contents of the PLC "C" memory, locations 300 to 327 (octal).

The MCCs are activated through isolated relay outputs from the PLC. This eliminates the need to guarantee that all MCCs are wired to the same phase of the AC line.
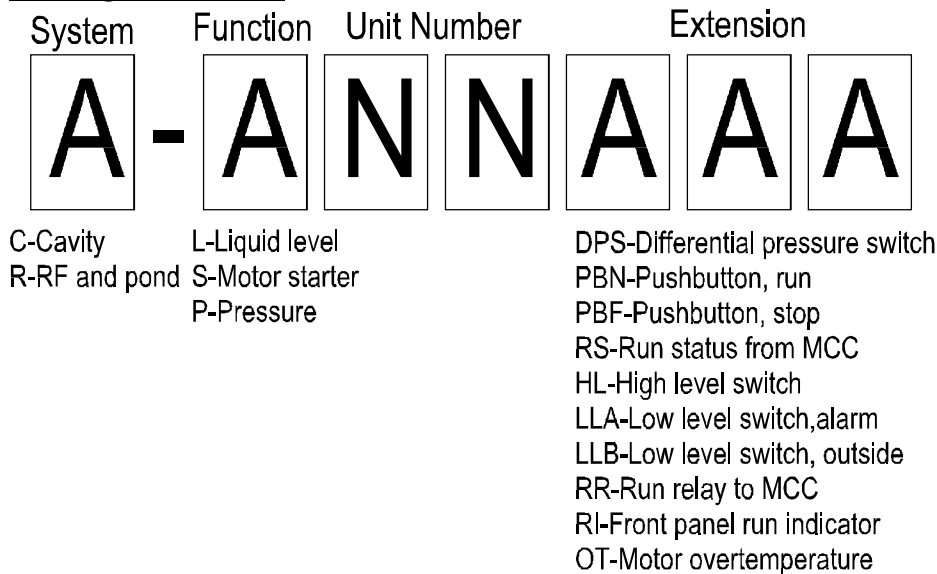
Spares and Documentation

Spare PLC modules are stored in the LCW control enclosure in the MI60N pump room. The spare processor module has been preloaded with the most current revision of the control program. The PLC program and other support files are archived at \\beamssrv1\kasley\lcw. Note that Optimation OMwin V2.21 Optimate Configuration Editor and PLC-Direct DirectSoft V2.3 are needed configure and program the OI panel and the PLC. Documentation is found on the Web at http://adwww.fnal.gov/controls/hardware_franck/.

I/O Points

PLC I/O is separated into monitor and control groups. Signals in the monitor group do not participate in any way in the logic that controls the MCCs. However, signals in the control group are used to generate status outputs in the monitor group.

A third signal group is concerned with local monitoring of system status. Each of eight motor-run indicators will be located next to its corresponding RUN and STOP switch. These indicators will be directly driven by PLC outputs. The remaining status bits will be displayed locally on a lamp annunciator panel. The annunciator panel talks to the PLC over a serial link. All status bits will be available to ACNET through the RF/Cavity LCW Control System (Sixtrak).

Naming Convention

System   Function   Unit Number   Extension

A - A N N A A A

C-Cavity   L-Liquid level   DPS-Differential pressure switch
R-RF and pond   S-Motor starter   PBN-Pushbutton, run
            P-Pressure   PBF-Pushbutton, stop
                                      RS-Run status from MCC
                                      HL-High level switch
                                      LLA-Low level switch,alarm
                                      LLB-Low level switch, outside
                                      RR-Run relay to MCC
                                      RI-Front panel run indicator
                                      OT-Motor overtemperature

PLC Control I/O

	NAME	DESCRIPTION	TYPE	ELECTRICAL
	Control Inputs			
i1	R-S01PBN	95? R01 run pushbutton	momentary pbs	NO, contact
i2	R-S02PBN	95? R02 run pushbutton	momentary pbs	NO, contact
i3	R-S03PBN	95? R03 run pushbutton	momentary pbs	NO, contact
i4	R-S04PBN	95? R04 run pushbutton	momentary pbs	NO, contact

i5	R-S06PBN	95? Pond 1A run pushbutton	momentary pbs	NO, contact
i6	R-S07PBN	95? Pond 1B run pushbutton	momentary pbs	NO, contact
i7	C-S02PBN	Cavity C02 run pushbutton	momentary pbs	NO, contact
i8	C-S03PBN	Cavity C03 run pushbutton	momentary pbs	NO, contact
i9	R-S01PBF	95? R01 stop pushbutton	momentary pbs	NO, contact
i10	R-S02PBF	95? R02 stop pushbutton	momentary pbs	NO, contact
i11	R-S03PBF	95? R03 stop pushbutton	momentary pbs	NO, contact
i12	R-S04PBF	95? R04 stop pushbutton	momentary pbs	NO, contact
i13	R-S06PBF	95? Pond 1A stop pushbutton	momentary pbs	NO, contact
i14	R-S07PBF	95? Pond 1B stop pushbutton	momentary pbs	NO, contact
i15	C-S02PBF	Cavity C02 stop pushbutton	momentary pbs	NO, contact
i16	C-S03PBF	Cavity C03 stop pushbutton	momentary pbs	NO, contact
i17	R-P01DPS	95? R01 pressure switch*	diff. pressure sw.	NC, contact
i18	R-P02DPS	95? R02 pressure switch*	diff. pressure sw.	NC, contact
i19	R-P03DPS	95? R03 pressure switch*	diff. pressure sw.	NC, contact
i20	R-P04DPS	95? R04 pressure switch*	diff. pressure sw.	NC, contact
i21	C-P02DPS	Cavity C02 pressure switch*	diff. pressure sw.	NC, contact
i22	C-P03DPS	Cavity C03 pressure switch*	diff. pressure sw.	NC, contact
i23	R-P06DPS	Pond pressure switch*, hi spd	diff. pressure sw.	NC, contact
i24	R-P07DPS	Pond pressure switch*, low spd	diff. pressure sw.	NC, contact
i25	R-S06OT	95? Pond Motor 1A overtemp	internal motor sw.	NO, contact
i26	R-L01LLB	95? tank low switch	GEMS 85350	NC, latching contact
i27	C-L01LLB	Cavity tank low switch	GEMS 85350	NC, latching contact
i28		95? R01 Klixon	Klixon	NC, contact
i29	(spare)			
i35	R-S07OT	95? Pond Motor 1B overtemp	internal motor sw.	NO, contact
	Control Outputs**			
o1	R-S01RR	Run command to 95? R01 MCC	NO Isolated relay output	120VAC
o2	R-S02RR	Run command to 95? R02 MCC	NO Isolated relay output	120VAC
o3	R-S03RR	Run command to 95? R03 MCC	NO Isolated relay output	120VAC
o4	R-S04RR	Run command to 95? R04 MCC	NO Isolated relay output	120VAC
o5	R-S06RR	Run command to 95? Pond 1A MCC	NO Isolated relay output	120VAC
o6	R-S07RR	Run command to 95? Pond 1B MCC	NO Isolated relay output	120VAC
o7	C-S02RR	Run command to Cavity C02 MCC	NO Isolated relay output	120VAC
o8	C-S03RR	Run command to Cavity C03 MCC	NO Isolated relay output	120VAC

*Input to be lowpass filtered before use in control program

** If power to the controller is lost, all MCC outputs are to fail open (MCC OFF)

PLC Monitor I/O

	NAME	DESCRIPTION	TYPE	ELECTRICAL
	Status Inputs			
i30		95? System LCW conductivity alarm	Conductivity monitor	NC, contact
i31		Cavity System LCW conductivity alarm	Conductivity monitor	NC, contact
i32	R-L01HL	95? tank high alarm	GEMS 85350	NC, latching contact
i33	R-L01LLA	95? tank low alarm	GEMS 85350	NC, latching contact
i34	C-L01HL	Cavity tank high alarm	GEMS 85350	NC, latching contact
i35	C-L01LLA	Cavity tank low alarm	GEMS 85350	NC, latching contact
i36	R-S01RS	95? R01 ON contact pair	MCC	NC, contact
i37	R-S02RS	95? R02 ON contact pair	MCC	NC, contact
i38	R-S03RS	95? R03 ON contact pair	MCC	NC, contact
i39	R-S04RS	95? R04 ON contact pair	MCC	NC, contact
i40	C-S02RS	Cavity C02 ON contact pair	MCC	NC, contact
i41	C-S03RS	Cavity C03 ON contact pair	MCC	NC, contact
i42	R-S06RS	95? Pond 1A ON HIGH SPEED	MCC	NC, contact
i43	R-S07RH	95? Pond 1B ON HIGH SPEED	MCC	NO, contact
i44		Air compressor air pressure low		
i45		MCC Annunciator status	MCC	?
i46	R-S07RL	95? Pond 1B ON LOW SPEED	MCC	NO, contact
i47	R-S07HS	95? Pond 1B HI SPD selected	MCC	NO, contact
	Watchdog Outputs			
o9		95? LCW system conductivity alarm	NO Isolated relay output	
o10		Cavity LCW system conductivity alarm	NO Isolated relay output	
	FIRUS Outputs			
o11	Trouble	95? LCW system conductivity alarm	NO Isolated relay output	24VDC
o12	Trouble	Cavity LCW system conductivity alarm	NO Isolated relay output	24VDC
o13	Utility	95? tank high alarm	NO Isolated relay output	24VDC
o14	Utility	95? tank low alarm	NO Isolated relay output	24VDC
o15	Utility	Cavity tank high alarm	NO Isolated relay output	24VDC
o16	Utility	Cavity tank low alarm	NO Isolated relay output	24VDC
o17	Trouble	95? pond pump 1A shutdown	NO Isolated relay output	24VDC

o18	Trouble	95? pond pump 1B shutdown	NO Isolated relay output	24VDC
o19	Trouble	95? RF R01 pressure pump shutdown	NC Isolated relay output	24VDC
o20	Trouble	95? RF R02 pressure pump shutdown	NO Isolated relay output	24VDC
o21	Trouble	95? RF R03 pressure pump shutdown	NO Isolated relay output	24VDC
o22	Trouble	95? RF R04 pressure pump shutdown	NO Isolated relay output	24VDC
o23	Trouble	Cavity C02 pressure pump shutdown	NO Isolated relay output	24VDC
o24	Trouble	Cavity C03 pressure pump shutdown	NO Isolated relay output	24VDC
o25	Trouble	95? RF low tank pump shutdown	NO Isolated relay output	24VDC
o26	Trouble	Cavity low tank pump shutdown	NO Isolated relay output	24VDC
o27	Trouble	Pond pressure fault (latched; cleared by pond motor start)	NO Isolated relay output	24VDC
o28	Utility	Air compressor air pressure low	NO Isolated relay output	24VDC
o29	Utility	MCC annunciator alarm	NO Isolated relay output	24VDC
o42	Trouble	Pond 1A overtemp alarm	NO Isolated relay output	24VDC
o43	Trouble	Pond 1B overtemp alarm	NO Isolated relay output	24VDC

Outputs passed to the RF/Cavity LCW System for ACNET monitoring

o30		95? pond pump 1A running	DC Output	24VDC
o31		Removed (was 1B running)		
o32		95? R01 running	DC Output	24VDC
o33		95? R02 running	DC Output	24VDC
o34		95? R03 running	DC Output	24VDC
o35		95? R04 running	DC Output	24VDC
o36		Cavity C02 running	DC Output	24VDC
o37		Cavity C03 running	DC Output	24VDC
o38		Pond pressure (latched)	DC Output	24VDC
o39		Air compressor air pressure low	DC Output	24VDC
o40		MCC annunciator alarm	DC Output	24VDC

PLC Watchdog Output

o41		PLC Watchdog Timer Reset	DC Output	24VDC

Local Status Indications

NAME	DESCRIPTION	LOCAL TYPE	ELECTRICAL

R-S01RI	95? R01 running indicator	LED Pilot lamp	24VDC
R-S02RI	95? R02 running indicator	LED Pilot lamp	24VDC
R-S03RI	95? R03 running indicator	LED Pilot lamp	24VDC
R-S04RI	95? R04 running indicator	LED Pilot lamp	24VDC
R-S06RI	95? Pond 1A running indicator	LED Pilot lamp	24VDC
R-S07RI	95? Pond 1B running indicator	LED Pilot lamp	24VDC
C-S02RI	Cavity C02 running indicator	LED Pilot lamp	24VDC
C-S03RI	Cavity C03 running indicator	LED Pilot lamp	24VDC
	95? LCW system conductivity low	Annunciator panel	Serial Data
	Cavity LCW system conductivity low	Annunciator panel	Serial Data
	95? tank high alarm	Annunciator panel	Serial Data
	95? tank low alarm	Annunciator panel	Serial Data
	95? tank low shutdown	Annunciator panel	Serial Data
	Cavity tank high alarm	Annunciator panel	Serial Data
	Cavity tank low alarm	Annunciator panel	Serial Data
	Cavity tank low shutdown	Annunciator panel	Serial Data
	95? pond pump 1A shutdown	Annunciator panel	Serial Data
	95? pond pump 1B shutdown	Annunciator panel	Serial Data
	95? R01 shutdown	Annunciator panel	Serial Data
	95? R02 shutdown	Annunciator panel	Serial Data
	95? R03 shutdown	Annunciator panel	Serial Data
	95? R04 shutdown	Annunciator panel	Serial Data
	Cavity C02 shutdown	Annunciator panel	Serial Data
	Cavity C03 shutdown	Annunciator panel	Serial Data
	Pond pressure fault	Annunciator panel	Serial Data
	Pond pump 1A motor overtemp	Annunciator panel	Serial Data
	Pond pump 1B motor overtemp	Annunciator panel	Serial Data
	RF start inhibit timer on / sys err	Annunciator panel	Serial Data
	Pond 1A high Speed Selected	Annunciator panel	Serial Data
	Air compressor air pressure low	Annunciator panel	Serial Data
	MCC annunciator alarm	Annunciator panel	Serial Data

Signals to FIRUS Monitored by the RF/Cavity LCW System (See K.C. Seino)

R-P04, R-P01	95? Pond water filter diff. pressure high
R-P27	95? nitrogen pressure low
C-P04	Cavity nitrogen pressure low
R-R03	95? LCW polishing bottle conductivity low
C-R02	Cavity LCW polishing bottle conductivity low
R-M01	Excessive 95? make-up water
C-M01	Excessive Cavity make-up water
R-T05	95? LCW temperature overrange
C-T01	Cavity LCW temperature overrange

Signals to Watchdog Monitored by the RF/Cavity LCW System (See K.C. Seino)

R-T05   95? LCW temperature overrange
C-T01   Cavity LCW temperature overrange

Overview of the RLL Program

a. Pond Water Pumps
Start a pond pump in response to its start switch. If the pond pump pressure switch opens or if the overtemp line closes, shut down the currently running pump, start the other pump, and set the corresponding pump shutdown alarm. Run the second pump until it is manually stopped. If the pond pump pressure switch opens or stays open, or if the overtemp line for the second pump opens, shut down the second pump, and set its shutdown alarm. Do not allow both pumps to run at the same time. If a pump has been tripped off, do not automatically restart it.

The pond pump MCCs are not interlocked to a sump pit level signal.

The 1B pump is actually two starter units; one for low speed operation and a second for high speed operation. The speed is selected manually by a switch on the MCC. The logic matches the speed selection with the high and low run contacts to interlock the motor.

b.   95? RF Pumps
Interlock all pump MCCs to the 95? tank low level switch. Interlock each pump MCC to its respective pressure switch.

Start any one pump by in response to its RUN pushbutton. Inhibit any other pump from starting for 10 seconds; pumps may be stopped during this period. Allow only 3 of 4 pumps to be running at one time. Do not automatically restart any pump.

c. Cavity Pumps
Same control as used for the 95? pumps.

d. Shut-down Indicators
An indicator illuminates on the annunciator panel and a FIRUS line is activated when the PLC stops a motor unit. These indications are automatically cleared when the corresponding RUN switch is depressed. They are also cleared by depressing the corresponding STOP switch.

e. System Error Indication
The INHIBIT TIMER ON indicator will flash if the PLC detects a internal error.

PLC I/O Base Configurations

SLOT	BASE 0 (CPU)	BASE 1 (REMOTE OUTPUT)
PS	120VAC PS	120VAC PS
CPU	DL240	D2-RSSS remote I/O slave
0	filler	F2-08TRS 8pt relay output
1	D2-RMSM remote I/O master	F2-08TRS 8pt relay output
2	filler	D2-16TD2-2 16pt DC output
3	D2-16ND3-2 16pt DC input	F2-08TRS 8pt relay output
4	D2-16ND3-2 16pt DC input	filler
5	D2-16ND3-2 16pt DC input	filler
6	F2-08TRS 8pt relay output	filler
7	F2-08TRS 8pt relay output	filler

Remote I/O Master unit address=00
Remote I/O Slave unit address=01
Remote I/O protocol=Rmnet, 19.2K

Optimate Annuciator Panel Setup
*Scans PLC V-memory locations V40614 through V40617 (C300-C377)
*Uses DL240 Port 2

PLC I/O Point Assignments
Note: 3K resistor across all FIRUS pairs at DIN rail connections

Base 0, Slot 3 16pt DC Input

ADR	CNL	DIN RAIL TERMINAL	TAG	DESCRIPTION	Type	Comment
X0	A0	1	R-S01PBN	R01 run pushbutton	NO	
X1	A1	2	R-S02PBN	R02 run pushbutton	NO	
X2	A2	3	R-S03PBN	R03 run pushbutton	NO	
X3	A3	4	R-S04PBN	R04 run pushbutton	NO	
X4	A4	5	R-S06PBN	R06 run pushbutton	NO	
X5	A5	6	R-S07PBN	R07 run pushbutton	NO	
X6	A6	7	C-S02PBN	C02 run pushbutton	NO	
X7	A7	8	C-S03PBN	C03 run pushbutton	NO	
X10	B0	9	R-S01PBF	R01 stop pushbutton	NO	
X11	B1	10	R-S02PBF	R02 stop pushbutton	NO	
X12	B2	11	R-S03PBF	R03 stop pushbutton	NO	
X13	B3	12	R-S04PBF	R04 stop pushbutton	NO	
X14	B4	13	R-S06PBF	R06 stop pushbutton	NO	
X15	B5	14	R-S07PBF	R07 stop pushbutton	NO	
X16	B6	15	C-S02PBF	C02 stop pushbutton	NO	
X17	B7	16	C-S03PBF	C03 stop pushbutton	NO	

Base 0, Slot 4 16pt DC Input

ADR	CNL	DIN RAIL TERMINAL	TAG	DESCRIPTION	Type	Comment
X20	A0	17	R-P01PS	R01 pressure switch	NC	
X21	A1	18	R-P02PS	R02 pressure switch	NC	
X22	A2	19	R-P03PS	R03 pressure switch	NC	
X23	A3	20	R-P04PS	R04 pressure switch	NC	
X24	A4	21	R-P06PS	Pond pressure switch, hi spd	NC	From pond vault
X25	A5	22	R-P07PS	Pond pressure switch, low spd	NC	From pond header (black pipe)
X26	A6	23	C-P02PS	C02 pressure switch	NC	
X27	A7	24	C-P03PS	C03 pressure switch	NC	
X30	B0	25	R-S06OT	R06 Overtemp	NO	
X31	B1	26	R-L01LLB	RF exp. Tank low shutdown	NC	
X32	B2	27	R-L01HL	RF exp. Tank high alarm	NC	
X33	B3	28	R-L01LLA	RF exp. Tank low alarm	NC	
X34	B4	29	C-L01LLB	Cavity exp. Tank low shutdown	NC	
X35	B5	30	C-L01HL	Cavity exp. Tank high alarm	NC	
X36	B6	31	C-L01LLA	Cavity exp. Tank low alarm	NC	
X37	B7	32		R01 Klixon	NC	

Base 0, Slot 5 16pt DC Input

ADR	CNL	DIN RAIL TERMINAL	TAG	DESCRIPTION	Type	Comment
X40	A0	33	R-S01RS	R01 ON contact (from MCC)	NC	
X41	A1	34	R-S02RS	R02 ON contact (from MCC)	NC	
X42	A2	35	R-S03RS	R03 ON contact (from MCC)	NC	
X43	A3	36	R-S04RS	R04 ON contact (from MCC)	NC	
X44	A4	37	R-S06RS	R06 ON contact (from MCC)	NC	
X45	A5	38	R-S07RH	R07 ON HIGH contact	NO	
X46	A6	39	C-S02RS	C02 ON contact (from MCC)	NC	
X47	A7	40	C-S03RS	C03 ON contact (from MCC)	NC	

ADR	CNL	DIN RAIL TERMINAL	TAG	DESCRIPTION	Type	Comment
X50	B0	41		95?RF system conductivity alarm	NC	
X51	B1	42		Cavity system conductivity alarm	NC	
X52	B2	43		Expansion tank air pressure low	NO	
X53	B3	44		MCC annunciator alarm	NO	
X54	B4	45	R-S07OT	R07 Overtemp	NO	
X55	B5	46	R-S07RL	R07 ON LOW contact	NO	
X56	B6	47	R-S07HS	R06 High speed select	NO	
X57	B7	48		(spare)		

Base 0, Slot 6 8pt Relay Output

ADR	CNL	DIN RAIL TERMINAL	TAG	DESCRIPTION	Type	Comment
Y0	NO0, C0	49		Watchdog 95?RF conductivity	NO	
Y1	NO1, C1	50		Watchdog cavity conductivity	NO	
Y2	NO2, C2	51		FIRUS 95?RF conductivity (mini card 1, #4)	NO	FIRUS #1 cable, BRN-BLK
Y3	NO3, C3	52		FIRUS cavity conductivity (mini card 1, #5)	NO	FIRUS #1 cable, RED-BLK
Y4	NO4, C4	53		FIRUS pond pressure fault (mini card 1, #6)	NO	FIRUS #1 cable, ORG-BLK
Y5	NO5, C5	54		FIRUS 95?RF tank low shutdown (mini card1, #7)	NO	FIRUS #1 cable, YEL-BLK
Y6	NO6, C6	55		FIRUS cavity tank low shutdown (mini card 1, #8)	NO	FIRUS #1 cable, GRN-BLK
Y7	NO7, C7	56		FIRUS MCC annunciator alarm (mini card 1, #9)	NO	FIRUS #1 cable, BLU-BLK

Base 0, Slot 7 8pt Relay Output

ADR	CNL	DIN RAIL TERMINAL	TAG	DESCRIPTION	Type	Comment
Y10	NO0, C0	57	R-S01RR	R01 run command (to MCC)	NO	MCC wire #4
Y11	NO1, C1	58	R-S02RR	R02 run command (to MCC)	NO	MCC wire #12

ADR	CNL	DIN RAIL TERMINAL	TAG	DESCRIPTION	Type	Comment
Y12	NO2, C2	59	R-S03RR	R03 run command (to MCC)	NO	MCC wire #14
Y13	NO3, C3	60	R-S04RR	R04 run command (to MCC)	NO	MCC wire #16
Y14	NO4, C4	61	R-S06RR	R06 run command (to MCC)	NO	MCC wire #6
Y15	NO5, C5	62	R-S07RR	R07 run command (to MCC)	NO	MCC wire #8
Y16	NO6, C6	63	C-S02RR	C02 run command (to MCC)	NO	MCC wire #2
Y17	NO7, C7	64	C-S03RR	C03 run command (to MCC)	NO	MCC wire #10

Base 1, Slot 0 8pt Relay Output

ADR	CNL	DIN RAIL TERMINAL	TAG	DESCRIPTION	Type	Comment
Y20	NO0, C0	65		FIRUS R01 shutdown (mini card 1, #10)	NO	FIRUS #1 cable, WHT-BLK
Y21	NO1, C1	66		FIRUS R02 shutdown (mini card 1, #11)	NO	FIRUS #1 cable, GRN-RED
Y22	NO2, C2	67		FIRUS R03 shutdown (mini card 1, #12)	NO	FIRUS #1 cable, BLU-RED
Y23	NO3, C3	68		FIRUS R04 shutdown (mini card 1, #13)	NO	FIRUS #1 cable, WHT-RED
Y24	NO4, C4	69		FIRUS R06 shutdown (mini card 1, #14)	NO	FIRUS #2 cable, BRN-BLK
Y25	NO5, C5	70		FIRUS R07 shutdown (mini card 1, #15)	NO	FIRUS #2 cable, RED-BLK
Y26	NO6, C6	71		FIRUS C02 shutdown (mini card 2, #0)	NO	FIRUS #2 cable, ORG-BLK
Y27	NO7, C7	72		FIRUS C03 shutdown (mini card 2, #1)	NO	FIRUS #2 cable, YEL-BLK

Base 1, Slot 1 8pt Relay Output

ADR	CNL	DIN RAIL TERMINAL		DESCRIPTION	Type	Comment
Y30	NO0, C0	73		FIRUS 95?RF tank high alarm (mini card 2, #2)	NO	FIRUS #2 cable, GRN-BLK
Y31	NO1,	74		FIRUS 95?RF tank	NO	FIRUS #2 cable,

ADR	CNL	DIN RAIL TERMINAL	TAG	DESCRIPTION	Type	Comment
	C1			low alarm (mini card 2, #3)		BLU-BLK
Y32	NO2, C2	75		FIRUS cavity tank high alarm (mini card 2, #4)	NO	FIRUS #2 cable, WHT-BLK
Y33	NO3, C3	76		FIRUS cavity tank low alarm (mini card 2, #5)	NO	FIRUS #2 cable, GRN-RED
Y34	NO4, C4	77		FIRUS air pressure low alarm (mini card 2, #6)	NO	FIRUS #2 cable, BLU-RED
Y35	NO5, C5	78		R07 running indicator	NO	LED 2
Y36	NO6, C6	79		C02 running indicator	NO	LED 7
Y37	NO7, C7	80		C03 running indicator	NO	LED 8

Base 1, Slot 2 16pt DC Output

ADR	CNL	DIN RAIL TERMINAL	TAG	DESCRIPTION	Type	Comment
Y40	A0	81	R-S01RUN	Sixtrak R01 running (60215 DI5-1)	NO	2-15 BLK
Y41	A1	82	R-S02 RUN	Sixtrak R02 running (60215 DI5-2)	NO	2-15 WHT
Y42	A2	83	R-S03 RUN	Sixtrak R03 running (60215 DI5-3)	NO	2-15 RED
Y43	A3	84	R-S04 RUN	Sixtrak R04 running (60215 DI5-4)	NO	2-15 GRN
Y44	A4	85	R-S06 RUN	Sixtrak R06 running (60215 DI5-5)	NO	2-15 BRN
Y45	A5	86		Removed (was R07 running)		2-15 BLU
Y46	A6	87	C-S02 RUN	Sixtrak C02 running (60216 DI4-1)	NO	2-16 BLK
Y47	A7	88	C-S03 RUN	Sixtrak C03 running (60216 DI4-2)	NO	2-16 WHT
Y50	B0	89		Sixtrak pond pressure fault (60215 DI5-7)	NO	2-15 ORG
Y51	B1	90	C-CMPRL	Sixtrak air	NO	2-16 RED

ADR	CNL	DIN RAIL TERMINAL	TAG	DESCRIPTION	Type	Comment
				pressure low alarm (60216 DI4-3)		
Y52	B2	91	C-MCCAL	Sixtrak MCC annunciator alarm (60216 DI4-4)	NO	2-16 GRN
Y53	B3	92		R01 running indicator	NO	LED 3
Y54	B4	93		R02 running indicator	NO	LED 4
Y55	B5	94		R03 running indicator	NO	LED 5
Y56	B6	95		R04 running indicator	NO	LED 6
Y57	B7	96		R06 running indicator	NO	LED 1

Base 1, Slot 3 8pt Relay Output

ADR	CNL	DIN RAIL TERMINAL	TAG	DESCRIPTION	Type	Comment
Y60	NO0, C0			Watchdog timer reset (mini card 3,#3)	NO	
Y61	NO1, C1			FIRUS Pond 1A overtemp (mini card 3, #9 via PV7 box terminals 11 & 12)	NO	
Y62	NO2, C2			FIRUS Pond 1B overtemp (mini card 3, #8 via PV7 box terminals 9 & 10)	NO	
Y63	NO3, C3				NO	
Y64	NO4, C4				NO	
Y65	NO5, C5				NO	
Y66	NO6, C6				NO	
Y67	NO7, C7				NO	

PLC Memory Assignments

C-memory

0	r01 running		1	r02 running	

2	r03 running		307	c03 shutdown
3	r04 running		310	rf conductivity
4	pond dps fault latch		311	rf tank high
5	cavity tank low		312	rf tank low
6	rf start inhibit flag		313	rf tank low shutdown
7	rf tank low		314	cavity conductivity
10	r01 filter		315	cavity tank high
11	r01 filter		316	cavity tank low
12	r02 filter		317	cavity tank low shutdown
13	r02 filter		320	pond high
14	r03 filter		321	MCC annunciator
15	r03 filter		322	air pressure
16	r04 filter		323	inhibit timer on /sys err
17	r04 filter		324	pond1a overtemp
20	r06 filter		325	pond1b overtemp
21	r06 filter		326	pond dps fault
22	r07 filter		327	Pond 1B high speed
23	r07 filter		330	x
24	c02 filter		331	x
25	c02 filter		332	x
26	c03 filter		333	x
27	c03 filter		334	x
30	rf1		335	x
31	rf1 one-shot		336	x
32	rf2		337	x
33	rf2 one-shot		340	C300 flash
34	rf3		341	C301 flash
35	rf3 one-shot		342	C302 flash
36	rf4		343	C303 flash
37	rf4 one-shot		344	C304 flash
40	(unused)		345	C305 flash
41	rf1 start enable		346	C306 flash
42	rf2 start enable		347	C307 flash
43	rf3 start enable		350	C310 flash
44	rf4 start enable		351	C311 flash
45	pond1a_tripped		352	C312 flash
46	pond1b_tripped		353	C313 flash
47	pond_1B_run		354	C314 flash
50	plc_err		355	C315 flash
	Optimate		356	C316 flash
300	pond1a shutdown		357	C317 flash
301	pond1b shutdown		360	C320 flash
302	r01 shutdown		361	C321 flash
303	r02 shutdown		362	C322 flash
304	r03 shutdown		363	C323 flash (sys err)
305	r04 shutdown		364	C324 flash
306	c02 shutdown		365	C325 flash

366	C326 flash
367	C327 flash
370	x
371	x
372	x

373	x
374	x
375	x
376	x
377	x

S-memory (*=initial state)

0	pond_idle*
1	pond1a_on_dly
2	pond1b_on_dly
3	pond1b_run
4	pond1b_fault
5	pond1a_run
6	pond1b_init
7	pond1a_fault
10	cavity_idle*
11	c02_on_dly
12	c03_on_dly
13	c02_run
14	c03_run
15	c02_fault
16	c03_fault
17	rf_start_inh*
20	rf1_idle*
21	rf1_on_dly

22	rf1_run
23	rf1_fault
24	rf2_idle*
25	rf2_on_dly
26	rf2_run
27	rf2_fault
30	rf2_idle*
31	rf3_on_dly
32	rf3_run
33	rf3_fault
34	rf4_idle*
35	rf4_on_dly
36	rf4_run
37	rf4_fault
40	dummy*
41	TOT_reset_H
42	TOT_reset_L
43	pond1a_init

Timer Usage

T0	rf motor start inhibit
T1	"
T2	R06 on delay
T3	R07 on delay
T4	c02 on delay
T5	c03 on delay
T6	r01 on delay
T7	r02 on delay
T10	r03 on delay
T11	r04 on delay
T12	tot high delay
T13	tot low delay
CT0	r01 filter
CT1	"

CT2	r02 filter
CT3	"
CT4	r03 filter
CT5	"
CT6	r04 filter
CT7	"
CT10	r06 filter
CT11	"
CT12	r07 filter
CT13	"
CT14	c02 filter
CT15	"
CT16	c03 filter
CT17	"

V-memory

2000	remote I/O initialization
2001	remote I/O initialization
2002	remote I/O initialization

2003	remote I/O initialization
2004	motor start-up delay intialization
2005	pressure filter initialization
2006	"
2007	"
2010	motor start inhibit initialization
2011	"